US-PAT-NO: 6600836

DOCUMENT-IDENTIFIER: US 6600836 B1

TITLE: Quality based image compression

DATE-ISSUED: July 29, 2003

INVENTOR-INFORMATION:

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APPL-NO: 09/ 494192

DATE FILED: January 28, 2000

US-CL-CURRENT: 382/239, 358/426.04 , 382/240

ABSTRACT:

A system and method for quality-based compression utilizing adaptively sized blocks and sub-blocks of discrete cosine transform coefficient data and a quality based quantization scale factor is claimed. A block size assignment element in an encoder element selects the block or sub-block of an input block of pixel data to be processed. Blocks with variances larger than a threshold are subdivided, while blocks with variances smaller than threshold are not subdivided. A transform element transforms the

pixel values of the selected blocks into the frequency domain. The frequency domain values are quantized either on a block by block basis or a frame by frame basis utilizing a scale factor that correlates with the quality of the image. The data is then serialized and coded in preparation for transmission.

9 Claims, 10 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 8

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Brief Summary Text - BSTX (21):
It is another feature and advantage of the invention to maintain quality image compression and bit **rate control** of data accompanying activities such as bursts of motion.

Brief Summary Text - BSTX (24):
It is another feature and advantage of the invention to utilize a quantization **scale** factor that adjusts with respect to the **AC coefficient** count of the DCT blocks that comprise an image.

Drawing Description Text - DRTX (8):
FIG. 6 is a flow chart of a quantizer **scale** factor based on an **AC coefficient** count of DCT blocks.

Detailed Description Text - DETX (3):

The present invention provides a quality based system or apparatus and method of image compression that takes into account both the image quality and computational efficiency in performing image compression. Controlling the bit rate of a truly variable rate system based on the goal of maintaining a target bit rate inhibits the purpose of maintaining a quality image. Instead, the present invention addresses **rate control** strategies based on quality.

Quality-based image compression systems may be on a block level or on a frame level. The block level system generally uses a greater number of encoded bits per frame than frame level control because the block level systems use more overhead bits for identification of the particular blocks.

Detailed Description Text - DETX (32):

The weights are selected based on empirical data. A method for designing the weighting masks for 8.times.8 DCT coefficients is disclosed in ISO/IEC JTC1 CD 10918, "Digital compression and encoding of continuous-tone still images--part 1: Requirements and guidelines," International Standards Organization, 1994, which is incorporated herein by reference. In general, two FWMs are designed, one for the luminance component and one for the chrominance components. The FWM tables for block sizes 2.times.2, 4.times.4 are obtained by decimation and 16.times.16 by interpolation of that for the 8.times.8 block.

The scale factor **controls the quality and bit rate** of the quantized coefficients. Thus, each DCT coefficient is quantized according to the relationship: ##EQU4##

Detailed Description Text - DETX (39):

where T is threshold, X (k,l) represents the DCT coefficient at location (k,l) within an N.times.N block, and M is the number of AC coefficients within an N.times.N block of DCT that exceed the threshold. A **scale** factor is then assigned (320) according to the number of **AC coefficients** exceeding the threshold T.

Detailed Description Text - DETX (41):

Another block based embodiment of determining the quantizer scale factor is a quantizer scaler based on rate distortion (134), and is illustrated in FIG. 7 (400). Generally, the rate distortion quantizer operates in a similar manner to the coefficient count quantizer, but requires more overhead bits depending upon how many scale factors are scrutinized. After the block size assignment, a slice of data comprising N.times.N blocks of data is selected (404). In a preferred embodiment, the slice of data comprises blocks of 16 rows by 16 columns of pixel data. A DCT is performed on the block of data (408), and further sub-blocks may be designated, as described in reference to FIG. 3. A threshold for each block of data is again determined (412) at any stage of the process. An average distortion D and an average

bit per pixel rate R is also determined (416). Then, using the relationship as described with respect to the coefficient count method, the number of AC coefficients that exceed in magnitude the predetermined threshold (M) is determined (420). A **scale** factor is then assigned (424) according to the number of **AC coefficients** exceeding the threshold T.

Detailed Description Text - DETX (45):

The quantizer scale factor may also be selected on a frame by frame basis. However, frame based **rate control** generally achieves lower average bit rates than the above described block based **rate control**. Further, frame based **rate control** requires more use of buffers, as bit transfers occur on a frame-to-frame basis, as opposed to a block-to-block basis.